39. $f(x) = \begin{cases} 3-x, & x<1 \\ ax^2+bx, & x\ge 1 \end{cases}$

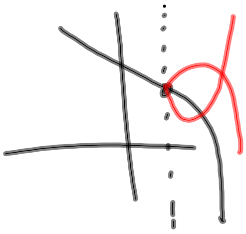
a) continuous $3-x = ax^2+bx \mid x=1$

$2 = a+b$

b) differentiable

$\lim_{h\to 0^-} \frac{f(1+h)-f(1)}{h}$

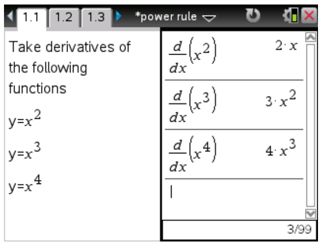
$\lim_{h\to 0^+} \frac{f(1+h)-f(1)}{h}$

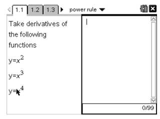


Sep 11-8:58 AM

3.3a Rules for Differentiation

Use Power Rule.tns to discover the power rule for derivatives





$\frac{d}{dx}x^5 = 5x^4$

$\boxed{\frac{d}{dx}x^n = nx^{n-1}}$ power rule

Sep 11-9:07 PM

Proof of the power rule

$f(x) = x^n \qquad f'(x) = nx^{n-1}$

$\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$

$\lim_{h\to 0} \frac{(x+h)^n - x^n}{h}$

$\lim_{h\to 0} \frac{(\cancel{x^n} + nx^{n-1}h + \frac{n(n-1)}{2}x^{n-2}h^2 \ldots + h^n) \cancel{-x^n}}{h}$

$\lim_{h\to 0} \frac{\cancel{h}(nx^{n-1} + \frac{n(n-1)}{2}x^{n-2}h \ldots + h^{n-1})}{\cancel{h}}$

nx^{n-1}

Sep 11-9:45 PM

$\frac{d}{dx} a\cdot x^n = n\cdot a\cdot x^{n-1}$ (clark rule)

$= a(nx^{n-1})$

$\frac{d}{dx} c\cdot f(x) = c\cdot f'(x)$

Sep 11-10:08 AM

Find $\frac{dy}{dx}$ if $y = x^3+6x^2-\frac{5}{3}x+16x^0$ $\qquad 0\cdot 16\cdot x^{-1} = 0$

$y' = 3x^2+12x-\frac{5}{3}$ $\qquad \frac{d}{dx}(c) = 0$

$\frac{d}{dx}[f(x)\pm g(x)] = f'(x) \pm g'(x)$

sum rule
difference rule

Sep 11-9:45 PM

Find the horizontal tangents of $y = x^4-2x^2+2$

by hand

$y' = 4x^3-4x = 0$

slope $= 0$

Solve for x

$4x(x^2-1) = 0$

with the calculator

$4x = 0$ or $x^2-1 = 0$

$x = 0$ or $x = \pm 1$

$y = 2 \qquad y = 1$

Sep 11-9:56 PM

higher order derivatives

$y = x^3$

$y' = 3x^2$

$y'' = 6x \qquad \frac{d^2}{dx^2}x^3 = 6x$

$y''' = 6$

$y^4 = 0$

$y^5 = 0$

Sep 11-10:02 PM